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Abstract

MULTI-GROUP CONSTANTS FROM INTEGRAL DATA

M. Humi, J.J. Wagschal and Y. Yeivin

The Hebrew University, Jerusalem, Israel

The G-group approximation in neutron transport calculations consists of replacing the correct, energy-dependent, Boltzmann equation, by the set of G-coupled equations

$$\vec{\Omega} \cdot \nabla \Psi_g + \alpha_g \Psi_g = \frac{1}{4\pi} \sum_{g'=1}^G \beta_{gg'} \varphi_{g'} \quad g = 1, 2, \dots, G$$

where Ψ_g and φ_g are the group angular and scalar fluxes, respectively. For simplicity, isotropic scattering was assumed. These equations involve $G(G+1)$ constant coefficients, the determination of which is usually a very delicate problem, (When anisotropic scattering is considered, the source terms are modified and involve more constants).

The common practice in determining these so-called group constants is to start from a set of basic cross sections which are then averaged with a proper weight function over the energy groups. However, there exists to date no satisfactory complete set of basic cross sections, and furthermore, one is not sure what the proper weighting function is.

Several unsuccessful attempts were made to derive sets of 'universal' group constants for many-group calculations. Certainly one cannot expect to derive by these 'conventional' methods reasonable constants for fewer-group calculations, applicable to a variety of systems. In principle it should be possible to derive the multi-group constants from integral data, rather than from the actual basic cross

sections. The purpose of this note is to illustrate and discuss this approach.

First should be decided what the purpose of a calculation is, and the quantities to be derived should be defined. Each such quantity forms a constraint on the manifold of possible sets of constants. If, for example, one is only interested in the eigenvalue (criticality), then obviously one still has many degrees of freedom in choosing one's constants.

The sets of constants for a certain system form a manifold in the proper hyperspace. Looking for a set of constants which will correctly describe several systems, one would naturally pick a set in the intersection of the relevant manifolds, if such an intersection actually exists. As more constraints, in the sense mentioned above, are imposed on our sets, the manifolds will shrink. As long as they still intersect, it will be possible to find a good set for all the systems.

This method is applied to several simple systems, and the derived constants are discussed and compared with the constants obtained by the conventional procedures.